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THE MATHEMATICS PROGRAM AND DECLINING ENROLMENT IN ONTARIO

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COMMISSION ON DECLINING SCHOOL ENROLMENTS IN ONTARIO (CODE)

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by

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A Working Paper for the
Commission on Declining School Enrollment (C.O.D.E.)

Dr. R. W. B. Jackson, Commissioner

About the Author

Dr. John Girhiny is a qualified mathematician and educator. He has taught at the elementary, secondary and tertiary levels of the educational system in Ontario. Included in his credentials are the following:

(1) Dean of Program for a comprehensive school with responsibility for all professional and curriculum development.

(2) Professional Development Co-ordinator (O.E.C.T.A.)

(3) Founding Director of the Leadership Seminars in Mathematics.

(4) Numerous executive positions within the Ontario Mathematics Commission.

(5) Addressed, by government invitation, the International Colloquium on the Theoretical Problems of Teaching Mathematics in the Primary Schools, Hungary.

(6) Addressed, by government invitation, the International Congress of Mathematics, Brazil.

(7) One of two teachers invited to represent the W.U.C.T. at the United Nations sponsored I.B.E. conference for Ministers of Education of member states.

(8) Several scholarly and professional publications.

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Introduction

This paper is a response to the request that the implications of declining enrollment upon the mathematics program be studied. Opinions of educators at all levels of education were sought as were the opinions of the business community. Further, a search of current literature was made but very little directly concerned with mathematics and declining enrollment was obtained. Material is included in the bibliography which concerns itself with professional and curriculum development in general. The specific adaptations should be obvious.

The first chapter contains the highlights of the deliberations of the task force established. It is somewhat rambling but is included to provide a flavour of what transpired. The author does not necessarily agree with any or all the statements made and has attempted to edit in an unbiased fashion.

The explorations have established five main foci of concern, namely,

(1) the need for balanced curricula adaptable to different learning styles;

(2) declining enrollment will mainly accentuate existing problems rather than creating new ones;

(3) meaningful values education is vital;

(4) professional development of teachers is critical;

(5) students learn from the methodology utilized as well as the subject matter presented.

A consideration of the minimum school size required to effectively provide multi-level mathematics programs is included. A methodology which has been field tested is then briefly described. The methodology has pedagogical meaningfulness as well as the sociological meaningfulness of providing a possible solution to the problem of multi-level mathematics programs and declining enrollment. Recommendations are listed at the conclusion.

Within the constraints present, the author has attempted to provide an insight into the future of mathematics education in Ontario. If clarity has been sacrificed for brevity in some areas, the author is prepared to attempt to rectify the situation upon request.

The Task Force

The author is indebted to the following gentlemen who agreed to form a Task Force to consider, within the time constraints given, the question of the effect of declining enrollment on the mathematics program:

Mr. Andrew Vertesi	-	Director, Computer Services and Budget, Mohawk College
Dr. Chester Carlow	-	Associate Professor, Ontario Institute for Studies in Education
Mr. Jim Wells	-	Department Manager, G. W. Robinson Company
Mr. Vern Pich	-	Co-ordinator, Business Programs, Mohawk College
Mr. Vince Frankovich		Head, Mathematics Department, Mohawk College

The terms of reference were to determine the problems in the mathematics program which would be caused or accentuated by the situation of declining enrollment. The original intention was to include in this report only the problems identified and their possible solutions but the deliberations of the group appeared to represent a cross-section of the population since some concerns of the individual members as parents and as students also were presented. Therefore, it is the author's opinion that the sharing of the highlights of the deliberations, without any concerted effort to organize them, would be of benefit to anyone considering the question of declining enrollment and its effect upon the mathematics program.

The impact of declining enrollment upon community colleges was first considered and it was agreed that at present there is no immediate impact there. It is speculated that, if the numbers should become sufficiently reduced so that some changes would be necessary, the most likely reaction would be to cancel some programs and amalgamate some others. The amalgamations would combine two- and three-year program students into one class. This would result in frustration for the two-year student or a reduction in the standards for the three-year program. In either case the market acceptability of the graduate would be reduced producing lower job placement results.

The perception of the business community is that the mathematics skill levels of high school or college graduates is very poor. In addition students appear to have no confidence in their own abilities. Certainly it can be stated that they have significently less confidence than graduates of previous years. This low level of confidence might result from fear of making a mistake or from inadequate practice time.

Very early in the discussions the consensus was reached that declining enrollment would only accentuate existing problems and therefore the main concern ought to be to determine existing problems and suggest remedies.

All institutions, university, college, business or industry, are concerned with the ability to determine correct answers to

problems and the ability to know why the answer is correct. Graduates should know and understand the process being used to obtain the answer. Certainly, technology can provide answers but whether the answers are correct or not and how they came eee about still must be determined by the human involved. A discussion of calculators in schools ensued, It was agreed that a calculator is wonderful if the person using it remains in the commanding position. A calculator can destroy the opportunity for a growing mind to grasp the structures and features of mathematics. A machine must be used with a person's mind working at the same time. Business still expects individuals to be able to perform arithmetic computations with accuracy and speed.

The query arose as to whether individuals really need to know how a computer works. The response was unanimous. Knowledge is necessary for design, for alternative uses, to protect oneself because of machine speed and to detect errors. Skills to be developed are estimation and accuracy in the use of the machine. An example cited is included. A computer manufactured by a reputable firm was found to be defective only because the individual using it had an undertanding of how it worked and kept his mind functioning at the same time as the computer was operating. In this case an $800,000 error was avoided. Similar errors of smaller magnitude but significant to the individual occur in the usual activities of life every day.

A recurring theme throughout the deliberations was the confidence problem. It was felt that school, as it is presently structured, is only a game for students and the harsh reality comes as they enter the job market at which time they realize that they are poorly prepared mathematically as well as psychologically for what is expected of them. Until this time the "penalty" was a loss of one credit which would not happen, if it happened at all, until four to eight months hence. Now a job and future employment is at stake. In school the students know that the majority of the class must pass. Under these conditions one wonders how the teacher impresses a sense of urgency and necessity upon the students especially in a generally permissive society. The general result is that little is demanded of the students. Some teachers try to impress students with the necessity for accuracy and care by reminding them that some will be doctors or engineers where a slight error would mean a loss of life or lives. Most students are not impressed for they do not have these aspirations. One teacher has tried to reach the students in this regard by quoting examples such as the airplane disaster in western Canada where there is some concern that either a radio operator or a snowplow operator might have been responsible for the terrible disaster. These illustrations bring momentary improvements.

Further concerns related to this same topic were expressed with respect to examinations which are generally poorly designed, which do not identify if a student has learned certain critical

items, which do not identify if the student is confident with them and which do not identify if a student has mastered a core and learned some of the peripheral items as well. Presently, a student only needs to obtain 50% on an exam or series of exams and "class work" to obtain credit. This mark does not even indicate that the student is familiar with half the work studied.

There were three factors identified as affecting teaching, namely, the logic of the subject matter, sociological conditions, and the psychology of learning (which includes the motivation of both pupils and teachers). Declining enrollment is a significant problem within the category of sociological conditions as are a generally permissive society and the lack of substantive tasks for young people in the real world resulting in a motivational problem. It was suggested that the reason why young people are frightened when presented with life problems is that they have never had to come to grips with a problem and resolve it themselves. In school, only in grade thirteen is there any programmatic challenge. Prior to this there are only isolated pockets of challenge. The students do not have any real life use of the mathematics learned. Guidelines should involve three levels of potential meaningfulness:

(1) potential logical meaningfulness
(2) potential sociological meaningfulness
(3) potential psychological meaningfulness

The first is concerned with the subject matter itself, the second with applications and the third with appeal to students.

Historically texts were very low in potential logical meaningfulness as they gave only the rules, very low in potential psychological meaningfulness having very little appeal or colour and very heavy on potential sociological meaningfulness with many examples relevant to the students out-of-class experiences. A former deputy minister of education is quoted as saying that almost everyone went to school until eighth grade and could do the problems in the texts. The difficulty began when the students no longer were involved in the activities listed in the texts.

In the era of the "new math", texts became very high in potential logical meaningfulness, low in potential sociological meaningfulness (few applications) and moderate in potential psychological meaningfulness. Presently most texts are high in potential psychological meaningfulness (a lot of appeal), poor in potential sociological meaningfulness (applications) and very weak in potential logical meaningfulness.

There is serious concern that the new intermediate guidelines will accentuate the problems. The attempt to make the programs more applied appears to be accomplished at the expense of logical meaningfulness. More will be said on this later. With declining enrollment and the resulting difficulties of job placement upon graduation the programs should be developed with a balance of all three factors so that the students would be flexible and have more opportunities available to them.

The need for "hands on" experience was identified. Parents should require their children to be involved in real-life experiences so that they would have an experience base from which to relate the mathematics studied in school. This is especially necessary now that the job market for part-time and occasional work is so poor. It was noted that some topics are studied earlier and with more ease by general level students than advanced level students because other practical courses give these students relevant experiences and make the topics meaningful.

Crucial areas ought to be identified and overlearned. From this base students should go beyond to more difficult items. In this way the student would become functional.

It is difficult to bring about change unless society supports it. Education is a total societal function. The question was asked if the lackadaisical attitude of students was a result of full employment, generous grants to universities and ready job markets. Similarly, the question was posed as to whether declining enrollment might bring about a positive change due to increased competition. Students might become more interested, more persistant and change their attitude. The concensus was that greater unemployment (more competition for jobs) would, in fact, undermine the motivation of students and would discourage them instead. Motivation is really needed early in school - from the ages of five or six and on up.

Declining enrollment is a result of fewer children. The fewer the children the more precious they will become. Parents will therefore press for improvements in education so as to avoid a mediocre education for their children. This will be reflected in society as a whole.

With respect to the proposed guidelines the task force felt that transformational geometry was not necessary, was superfluous, and appears to have been included to look innovative. Most students do not need geometry for their future activities. At the naive intuitive level where geometry touches the life of everyone it is easier to comprehend relative to the particular situation. The appropriate discipline in secondary school, e.g. geography, economics, design, could point out the items with greater relevance and retention. Transformational geometry is better appreciated by those who have studied traditional geometry first and can recognize its powerfulness. Transformational geometry is viewed by many as being worse than the overemphasis on set theory and abstraction of the past.

It is the feeling of the task force that the provision of five levels (plus possibly an enriched level) is impractical for many reasons. At the opposite extreme one level would not suffice. Both extremes of complete individualization and complete uniformity have been employed in schools. Both have failed basically because neither approach is in harmony with how people learn. No single uniform methodology is appropriate for all.

An illustration in the form of a personal anecdote made the point well. One level will not suffice for many reasons including the fact that the brighter student will not be challenged thereby undermining the entire school. The logical component will be missing and the obvious choice of using the informal approach will be detrimental. The individual approach often denies the group support and interaction necessary for some students.

This automatically raised the issue of the importance of a good foundation. Business looks at college graduates for management potential which necessitates a sound base and proper attitude, On-site training is provided. High school graduates are given three months to show management potential. If this is not the case the individual is redirected. Most do not stay in business as industry provides better pay for this type of individual. The importance of a good attitude continues to be stressed. It is impossible for schools to prepare students for all possible potentials as there are too many and they are extremely diverse. Numerically it is not feasible. Hence a good general foundation is the only viable alternative and it is of paramount importance.

In an aside a serious problem of effective communication was raised - communication between panels (elementary, secondary, tertiary) and within panels. Who must bear the onus for communication?

Two levels of mathematics at the secondary level is proposed with the difference being the additional topics studied and the depth to which they are studied. Both streams would be expected to understand and follow the logic but the top stream would cover material faster and deal with more complex items.

This area was discussed at length and will be further elaborated upon later in this document. There was serious concern as to present standards. Programs are only as good as the personnel using them. It is felt that further professional development of the teachers is necessary and crucial. (The reader is referred to Professional Development and Declining Enrollment in Ontario by this author.) The majority of professional educators are not sufficiently versed in mathematics to do justice to the teaching of it but most are required to teach mathematics anyway. The quality of teachers needs to be examined to determine if and what policies can be implemented.

Business and industry have definite rules to be followed and students should be prepared in schools to follow this discipline. At the same time, creative approaches are necessary. Individuals need to differentiate between profitable creativity and wasteful whimsy. Research and criteria are used in business and industry to make evaluations. A similar approach ought to be used in education.

Standards need to be set. An evaluation process needs to be established to determine if standards have been met. A standardized

exam is not the answer. A comprehensive exam near the end of the secondary school program is impractical.

The potential for better education is present since there will be more taxpayers supporting fewer students.

Curriculum development needs to take cognizance of different learning styles and provide direction to the teacher as to how he/she can accommodate the curriculum to the student. To this time, curriculum development has not been based upon the different learning styles of the reflective, safety oriented, impulsive and mixed student.

To conclude the deliberations each member of the task force was asked to identify a major issue. The following represent the responses given.

The Ontario Mathematics Commission was an excellent vehicle for bringing together dedicated people with different viewpoints and different backgrounds in order to establish a better mathematics program. Possibly O.M.C. should be resurrected, the mechanism exists, and should be funded by the Ministry to continue to monitor existing and proposed mathematics programs. Actual cost is minimal and negligible relative to gain. The frequency of meetings could be changed to permit a different number of meetings during different years as the situation dictates.

The perceived immaturity of students is expected to continue and to become more serious. Parental involvement in the raising of their children will be critical. Declining enrollment probably will increase the differences in background of graduating students as courses are abolished or amalgamated in some schools. A good foundation and a proper attitude will become crucial.

The deletion or amalgamation of courses should be on the basis of the needs of postsecondary institutions for continuing students and the needs of employers in the case of terminating students. The mathematics program will have to become more substantive and will have to provide a better foundation than at present. This will necessitate the reversion of some secondary topics to the elementary panel.

Anxiety of teachers is viewed as a major problem and managerial solutions will not solve the real problems or give confidence and enthusiasm to teachers. A task force ought to be established by the Minister of Education to design a school system to suit the anticipated environment. A band-aid approach is not possible and is wasteful.

If funds are maintained one should guard against the course of adoption of fads. This might result as one attempts to accommodate the surplus teachers and classrooms. A balanced program ought to be initiated with all the attending mechanisms to ensure implementation.

Adult education is expected to increase and a solid foundation should be established so that funds expended in the area of adult education would be fruitful instead of wasteful repetition.

A new humanism ought to be initiated where students are given the opportunity to experience a genuine sense of accomplishment. This, of necessity, permits the possibility of failure. A student should face a program of successive reasonable challenges geared to his/her particular learning style.

Problems Identified

It is difficult to deal with a myriad of problems if they are simply strung out like beads on a very long chain. There is a connection, of course, but the how is not clear. Thus the author has attempted to organize the main problems identified in chapter one. With this particular organization it is hoped that some solutions might become clear. The interconnections are so complex that any organizational attempt has its deficiencies. The problems identified are grouped as to personnel, curricular and other.

In attempting to project the effect of declining enrollment upon the mathematics program the main impact appears to be the accentualization of existing problems. At present, it is not clear what problems, if any, will be created as a result of declining enrollment. Having stated this one can then direct one's attention to the identification of existing problems which would continue or become more intense with the advent of declining enrollment.

In considering personnel problems one becomes increasingly involved rapidly. The major problem of students appears to be their lack of confidence and maturity. This may not be peculiar to mathematics. In this paper, consideration will be restricted to that discipline.

One suspects that the apparent lack of confidence and practical maturity in terms of mathematics results from a combination of the nature of the student, the program, the teachers, the parents and society in general. Learning is dependent upon the logic of the subject matter, the psychology of learning and sociological conditions. Declining enrollment is a sociological condition as are a generally permissive society and the lack of substantive tasks for young people in the out-of-school world thereby reducing motivation. In this way, then, declining enrollment will have a real impact upon the mathematics program.

Mathematics texts lack programmed challenges. Programmed challenges may appear in the grade thirteen text but this is far too late. Most teachers follow texts quite closely and so most mathematics programs lack programmed challenges. There is considerable question as to whether teachers are adequately prepared, academically or pedagogically, to effectively teach the mathematics program. The professional development of the teacher needs to be enhanced. (The reader is referred to Professional Development and Declining Enrollment in Ontario by this author.) Better texts would help. However, these would only be effective in the hands of better prepared teachers. Both of these would provide little benefit unless society endorses their thrust. Some teachers have tried to stem the tide but in many cases have been met by pressures from administrators, parents, fellow teachers and society in general to be "less demanding." The problem even exists at schools specifically

established to promote excellence when the graduates of these schools are compared with others for university entrance and scholarships. Recent press coverage of the situation has made more people aware and might assist in alleviating the condition.

Schools have difficulty in redirecting the home thrust. Parents must remain responsible for providing opportunities for their children to mature mathematically, to expect them to assume numerical tasks of importance to the family from an early age as they are capable and to support educators as they continue the process. This will be of more importance as the opportunities for part-time employment become more scarce. It has been shown that early motivation is necessary.

Parental pressure may grow to demand better educational programs not only because society tends to increase its demands in general but also because parents tend to want more for their only son or daughter. If this should happen a government which cannot demonstrate progress to this end will lose favour with the electorate. A redirection in education is a long process and must be begun immediately given the current situation.

Actual experience in applying mathematical principles, i.e. the establishment of concrete foundational experiences, greatly enhances learning. This should be obvious to anyone. It is attested to by the introduction of some topics, such as trigonometry

significantly earlier in the general level mathematics program than in the advanced level solely because concurrent courses in other disciplines provide the need for them and the opportunity to apply them.

The prospect of poor job opportunities is very discouraging. It is discouraging to adults who are faced with unemployment and to students who see unemployment as a distinct possibility for themselves. It is disconcerting to the entire society to see such resources wasted. Unemployment insurance and welfare payments do not contribute to growth but rather generate distrust in a government which cannot remedy the situation.

The lack of confidence present in students is a result of students becoming aware that little is expected of them, insufficient practice is accomplished and very few items are learned thoroughly. Students do not see any unity and cohesiveness to mathematics since it is presented to them as a series of isolated bits. Further contributing factors are poor evaluation devices and a humanism which is to their detriment. Evaluation practices are often poor. They seldom inform the student, almost always result in a mark, do not diagnose problems and are not followed up by remedial teaching and learning. Here both teachers and students are at fault. Further discussion of this point takes place in chapter five.

A new humanism is required where students are given opportunities for genuine success (which entails opportunities for failure) bearing in mind their different learning styles and capabilities.

A balanced program is required. Such a program would involve logical meaningfulness, applications and appeal. As well, it would recognize the different learning styles of students. It would provide for the reflective child, the safety-oriented child, the impulsive child and for those that are a combination of the above. Research is available on these learning styles, but more is needed. To give just one indication, research has shown that the best motivation is achieved for a safety-oriented child when he/she has a success rate of approximately 80% and for the reflective child the success rate must be at 70%.

The present levels of instruction offered are not appropriate for a variety of reasons. Students and parents misinterpret the significance of the levels or are misinformed about them. The divisions, as explained and practiced, are not appropriate. The new intermediate guideline that provides for five levels does not appear to be realistic. A clearer expectation of the standards to be achieved, items essential to mathematics development and the number of additional topics dealt with all should be indicated. There is a strong feeling that a good general foundation is and will be the best that can be achieved. The new guideline is seen to be a step in the wrong direction. Some of the precious little unity present is removed and the topic of transformational geometry is particularly poorly received. Further discussion of the guideline appears in chapter three.

One of the most significant problems is the lack of communication between various levels of interested parties, between schools and between disciplines within a school. There has been improvement of late but the communication system is still weak. Some ideas have shown remarkable success, such as the family of schools concept as applied to particular disciplines, while others, particularly secondary school chairmanships, are dismal failures. Combine this with fewer teachers teaching more subjects and improvement becomes difficult. The bridge between tertiary and secondary or between employer and secondary does not even have its footings yet. Whose responsibility is it to ensure adequate communication takes place?

Presently there is no effective forum to bring together parties interested in mathematics education. Until recently, the Ontario Mathematics Commission was able to achieve this goal. With its retirement, for financial reasons, no such effective forum exists. Possibly the Ministry of Education should contact the last president to request that the Ontario Mathematics Commission again become functional. It could be an excellent advisory body to the Ministry and the cost to the Ministry, even if it funded O.M.C. entirely, would be relatively minimal.

Managerial solutions will not solve the problems. Such solutions only treat the symptoms and not the illness itself. Further, the treatment is of the band-aid variety rather than being holistic. A comprehensive approach is necessary. Since manpower is currently available it appears to be opportune that one seize the moment to do what has escaped doing for so long as a result of the human resources not being available. Current policy is reactive resulting from the need to solve urgent problems. Possibly the current economic situation will prompt those in the positions of authority to begin to deal effectively and in a comprehensive manner with the problem before reactive measures are required. The students of the present and future deserve it. Those who will find themselves in increasing numbers in adult education in the future deserve it so that they can be involved in meaningful adult education.

Ministry Guidelines

During the preparation of this report and previously this author has been made aware of increasing criticism of Ministry guidelines. The proposed intermediate guideline has been particularly negatively received. So strong has been the reaction that it was decided to devote a separate chapter to the main questions at hand.

It is expected that five levels of instruction (not including a sixth for enrichment) in mathematics as proposed will not be practical in many schools especially in the light of declining enrollments (see chapter four.) There is no indication as to how teachers and schools are expected to cope with all these levels especially with reduced enrollments. At the same time the current situation is less than satisfactory. Two levels of credit would probably suffice, if properly defined, with a third available for students with particular difficulties if the fiscal resources were available. The two levels of credit would be redefined from the present. Currently the practice is for students who intend to go to university to take level five and for all others to take level four. This causes hardships and frustrations for those university bound in disciplines completely remote from mathematics and for college bound students who find that level five mathematics is really preferable. The two levels could be taught either in the same class (see chapter five) or in separate classes. With suitably talented teachers the exceptionally talented student also could be challenged in the same class. The distinction in the two levels would be based upon whether the student expected to enter a field where mathematics was required or not. Possibly

the labels could become more acceptable - life mathematics for those not choosing a mathematics related career and occupational mathematics for those who are. Life and Occupation mathematics - there are some who might say we have hit a new LO (pardon the levity.)

This approach necessitates the establishment of clearly defined standards, of core items to be mastered, of a minimum and suggested maximum number of additional topics together with a degree of learning for these (e.g. recall, recognition, performance, understanding, application, etc.) and the distinguishing features between the levels. The mastery of core items is to be interpreted as the "overlearning" of these items. Students are granted a credit only when these items are demonstrated at an eighty to ninety percent accuracy rate both in the short and long term. This would also answer the complaint that currently there are no standards.

Current practice requires the student to achieve a mark of fifty per cent, usually on a series of tests, classwork and exam(s) to obtain a credit. The evaluation process used is seldom diagnostic and almost always punitive. There is much need for improved evaluation procedures. Evaluation procedures need to be included in the guidelines to give direction to teachers, principals, etc. as to expectations for mastery, recall, recognition or comprehension level of learning and methods to assess the achievement of same. Presently there is no differentiation in achievement required between critical items and peripheral items,

To meet the needs of the individual student indications should be given in the guidelines of at least the basic types of student, reflective, safety-oriented, impulsive, mixed. Not only should these be mentioned, briefly described and some brief characterization of each presented but direction should be given as to how the curriculum should be adapted for each of these types of students.

This is not a covert way of sneaking in more levels. Nor is it a reduction or simplification of the teacher's work load. It is simply an attempt to develop each student to his/her fullest potential while at the same time reducing the proliferation of courses and credits. It is expected that courses designed this way would answer the current objectors who claim a lack of standards without introducing the retrograde step of province-wide exams. They would provide less frustration for students, would provide more challenging and meaningful instruction, and would better prepare students for the future.

The missing ingredient of programmed challenge should be included. With the inclusion by the Ministry, publishers would introduce the feature into their texts and hopefully the concept would reach the classroom. Programmed challenge, simply stated, causes the student to face a series of organized problems throughout his/her academic life, each requiring growth within the student but only requiring a growth which the student can reasonably achieve.

Present and proposed guidelines are not as balanced as they should be with respect to inherent logic, application and appeal. The current trend is toward application and appeal at the expense of the logical. This is not to suggest an extreme swing. The problem is precisely in the extremes. This author is advocating a program which includes a proper balance of all three components....

As was stated in Professional Development and Declining Enrollment in Ontario educational change can only be achieved by the co-operative efforts of all who are involved in the educational sphere. The key to implementation of any program is personnel. Extensive professional development is required to bring about this redirection. It is also necessary in order to implement the new topics proposed in the intermediate guideline. Some of the topics suggested are completely foreign to practicing teachers, even to some quite knowledgeable in the field of mathematics.

Topics such as transformational geometry will create the same intense negative reaction as the extremes of abstraction in the "new math." The need for geometry is questioned by many parents. Some see geometry as an attempt to lower standards within mathematics programs. Geometry is as demanding as other branches of mathematics but the applications for most people are obscure. The introduction of transformational geometry would be

viewed as an extreme step along this path. This view would also be shared by educators as well as the students. There is no question that transformational geometry is a powerful tool - it is simply inappropriate at the secondary level especially at the expense of other skills. Would it not be better to leave transformational geometry to tertiary education where ready applications in crystalography, holography, etc. are present?

Formal introduction of some other topics would be wasteful. If these are treated in an intuitive manner, as one believes is the intent, then the balance of the program is destroyed. The curriculum will become too informal. Such intuitive treatment is better accomplished in the other disciplines where it is used-dilitations in geography, matrices in economics and geography, flips and slides in art, et cetera. Guidelines for these other subjects ought to point out the mathematics used. There is far too much fragmentation of content at the present. Efforts to integrate the subjects should be continued. This is an excellent opportunity to do so. Pupils should view their education as a totality and not as a collection of fragments endured with no correlation to real life and with no correlation between disciplines.

This leads us immediately to comment on the lack of unity within any mathematics course. Until the proposed guideline was released the grade ten course (five year) was the best example

of a unified program. It could be taught (and should be taught) from a linear function theory approach. One had the opportunity to relate functions, equations, graphing, geometry and number theory all through the unifying concept of the straight line. Students, for the first time, had an opportunity to appreciate what the study of mathematics was really all about. Most often students were so busy planting trees here and there that they never had the opportunity to appreciate the beauty of the resulting forest. The proposed guideline makes this unifying approach virtually impossible. No longer can one grapple with a problem in one sphere and solve it by transferring the problem to another - algebra, equation theory, function theory, geometry - more appropriate sphere and transferring the answer back. This basic process is now lost. There are so many isolated bits that unity is virtually impossible. This author, and many others, regrets the direction proposed. It is hoped that the thrust will be re-examined and changes will occur prior to the release of the final version. If students do not get a feeling for this approach until grade twelve, thirteen or later then they will be completely overwhelmed by the content to be studied. They will not have the assistance of this technique nor will they have the time to discover it. It is incongruous that a statement encouraging unity should appear on page eleven while the diverse topics presented make such an approach almost impossible.

One must take exception to a section of the rationale on page one of the draft copy of Intermediate Division Mathematics 1977.

The guideline "is concerned with applying mathematics to today's world with a view for the future - rather than the past. It is not concerned with abstract structures of mathematics." One is amazed by the naivity. One can only cope with the future by a solid understanding of the processes used in the past. One first examines if an existing procedure will solve a new problem. If not, then one checks to see if the process can be modified to bring about the solution. Failing this one identifies the essentials of the solution and the new question and creatively attacks these in the hope of building a new procedure. To suggest that one can prepare for the future without an understanding of the mathematical past is absurd. Equally so, is the suggestion that one can be not concerned with abstract structures. One can only solve future problems by recourse to the abstract. Trial and error solutions were abandoned as the main method of resolution many years ago. The experimental approach is often inefficient and is always too expensive in dollars, in time and in lives. Success in space would never have been achieved without abstractions. Theories were developed and these are a result of abstraction. One could go on at length in a similar vein but let us conclude.

On the same page the following statement is made. "A major aim of the Intermediate Division Mathematics Curriculum is to develop in students the mathematical literacy they would need for productive lives now, and in the future." One applauds this motherhood statement but one must really question if this is possible. Most people gave up predicting future needs a few years ago. It now appears that predicting the future needs

in any area, let alone for the entire population, is impossible. The world simply changes too rapidly. It would be better to adopt as a major aim the task of developing within students the process of critical thinking so that they do not rely upon the "have I seen this one before?" method.

Before concluding this chapter there is a compulsion to mention rigid guidelines and rigid course outlines. This author is not advocating either. The basic thrust, as first exemplified by Senior Mathematics, is very good. There are some improvements possible. One can be somewhat more specific and yet not infringe upon local adaptations or individual's needs. The above description is intended to be just that. It is expected that by being more specific as outlined there could be allowance for greater flexibility. Rigid course outlines at the school or board level are equally to be avoided. They are unduly restrictive to the good teacher and of little benefit to the poor teacher. Permanently tentative outlines would be helpful but these would require more time than is currently available and personnel better prepared to write them than is currently possible. (More on this subject in chapter five.) Something is needed but what one introduces should be carefully scrutinized lest it be more damaging than nothing.

The Numbers Game

With the advent of declining enrollment schools will have to examine carefully the number of courses to be offered. Courses identified as peripheral will be the first to go. This stage will have little effect upon the mathematics program except possibly for courses such as computer studies, informatics, business math, etc.

Since almost everyone takes mathematics for the first four years one can assume a minimum school size based upon an examination of the number of students taking mathematics.

Despite P.T.R.'s which might lead one to conclude otherwise, class loadings in mathematics courses are usually between 30 and 40 students. We will use 30 as an average loading for all years except grade thirteen.

In an unsemestered school, if only one section of each course is taught one would require 450 students as a minimum school size. This is based upon five levels of grade nine of thirty students per class, similarly for grade 10, two classes of thirty in each of grades 11 and 12 and thirty students in grade thirteen. This assumes total retention throughout and an "ideal" distribution. For a semestered school the minimum number is 900. This does not allow for computer studies or any specialized mathematics courses such as business mathematics.

The question now becomes whether this is a realistic minimum size. Assuming 150 grade nine students one would not reduce to sixty for grades 11 and 12. The distribution at the grade

nine level would probably be more in the fashion of 10-15 students seeking enriched programs, 50 students expecting to follow the 5-year program, 50-60 expecting to follow the 4-year program and 15-30 students to be divided among the three other levels proposed. A school cannot afford to establish an enriched level for 15 students and so we have approximately 60 students to be accommodated in 2 sections of level 5 mathematics. Similarly two sections of level 4 mathematics would be required. If the school is to follow the spirit of H.S.1 and therefore provide three sections for the 15-30 students we would find nearly ideal situations for these students but absolute havoc for the school P.T.R. Assume for the moment that these students are accommodated somehow. We now have two sections each of level 4 and 5. This will continue throughout the secondary school requiring four sections in each of grades 11 and 12 and providing 50 students for grade thirteen. This would require two sections of calculus and one each of the other two mathematics courses. The minimum school size has now become 590 students and the P.T.R. (for math) is now 22.5:1 which is unacceptable for mathematics courses on a cost basis. All of this still assumes that the school is only providing the basic program and that teachers loadings will fit exactly.

For a semestered school one could offer the first three levels only during one semester and the other two levels on the basis of one section per semester. In this way the minimum school size could be reduced to 600 with a P.T.R. of 22.5:1. In addition this would remove the flexibility normally present in a semestered school.

Given this less-than-satisfactory solution let us approach the problem in another fashion. Assuming approximately 10 per cent of the student population would elect one of levels 1, 2 or 3 and assuming a class loading of 15 we discover that a grade nine population would have to be approximately 450 students to make this section feasible. Let us be more generous and say 350 would be adequate. With these numbers we find that the minimum school size rises to 1425 and the P.T.R. is 27:1 which is acceptable. For a semestered school the numbers are similar with levels 1, 2, 3 being offered only during one semester of grades nine and ten.

All of these calculations lead one to conclude that the offering of five levels is not feasible on the basis of one section per level. Even with levels 1, 2 and 3 combined into a single section one finds the minimum school size to be 590 and a P.T.R of 27:1. This is feasible but only in the ideal model. Will the students distribute themselves as per the model? Can one teacher effectively deal with 3 levels of students in one class? Can a school afford to offer so few mathematics options? What sort of total option offering can the school make to its students?

The situation is bleak. Schools of this size exist. More will fit into this category. The commissioner's report will indicate how many. Is the answer to consolidate schools still

further? This author suspects not, but again the commissioner will address this situation in greater detail. This author suspects that the answer lies in a teaching approach which does not require one section per level. Such an approach is proposed in the next chapter. It was originally designed for another purpose entirely. It was subsequently used for still another purpose. Possibly it can solve the dilemma of declining enrollment and improve the educational opportunities for students as well.

A Methodology

As was mentioned, the approach to be described in this chapter was designed for purposes other than to cope with declining enrollment. It is a pedagogical approach which can be used in almost any situation. It originated as an attempt to deal with different levels of students placed in one class so that students might be able to change from one level to another with relative ease. In streamed classes students usually could not change phase (level) during the year without a massive reorganization of their timetable. This was usually impractical. Timetabling different phases simultaneously was found to be impractical. Hence, students endured their lot for the year or semester. If it were too easy they would become bored, do poorly and have to lose another year or semester gaining the next higher phase. If it were too difficult the students would experience intense frustration and discouragement. It was hoped that by time-tabling them together the teacher could permit a change of phase during the year. Unphased classes provided students seeking an enriched course as well as those whose mathematical accomplishments to date had many deficiencies. Using the usual teaching approach simply did not work.

Some Philosophy

A sound pedagogical strategy has as one of its bases a particular philosophy. An understanding of the philosophy is

essential to an appreciation of the procedure. Permit this author, therefore, to relate the underlying philosophy with respect to the proposed methodology.

Learning begins when a student seeks the answers to his/her questions. Curriculum can and should be developed from the student's immediate environment. The teacher's job is to place the children in strategic positions for making explorations. A fixed curriculum is an anomaly if we consider children and environment two of the cornerstones upon which curriculum is built. The curriculum must be permanently tentative. The curriculum is fluid, though never unplanned. Teachers are responsible for developing it. To teach means to facilitate learning. We must avoid the model of teacher as dispenser of knowledge. Possibly we would remove the word "teach" from the educational vocabulary so that one would emphasize that the learning and the learner are the most important aspects. Without learning all teaching is a failure. Hence one cannot think about curriculum without thinking about children.

Not all children develop at the same rate. Teachers need to accept that there are ups and downs in the normal development of any one child. Learning stops when students stop asking questions. If students ask questions they deserve the opportunity to have them answered. Questions may be factual. Questions may be comprehensive. Real teaching takes place when the student asks questions like "How are these related?"

Let us illustrate. A memorization and regurgitation of the methods of food preservation might be helpful. But, the real learning takes place when the student realizes that all those methods have one common aim, namely, to prevent bacteria and mold from growing on the food. You need to know how bacteria live and then you are ready to develop new methods to suit new situations.

There are no such things as stupid questions. Certainly some individual might disrupt proceedings by attention seeking questions but this usually indicates that this particular student has not become interested as yet. The burden is always on the expert to determine why an individual does not understand something. The responsibility for learning is the individual's. Therefore, teachers bear the burden of diagnosing the problem but the learner must retain the responsibility for learning. So often this situation is reversed. The teacher wittingly or unwittingly removes the responsibility for learning from the student but gives him/her the burden of determining why he/she hasn't succeeded.

Curriculum needs to be fluid though never unplanned. Subject matter prearranged in a particular order provides for growth in only one direction.

Teachers need to be interested in what they are teaching for this excitement is contagious. Motivation is half the battle. A teacher needs to recognize his/her own learning style and understand it. In this way the teacher can recognize the learning style of others and appreciate it.

Struggling with new, difficult concepts is an important stage in learning. Frustration should be removed and replaced by a healthy curiosity and desire for challenge.

Teaching by setting up a classroom that invites children to learn and teaching from a developing curriculum is an art that takes insight, knowledge and many years of experience to perfect. Very few teachers are trained to teach this way. Very few do teach this way. Teachers who invite students to ask questions, to learn, must be prepared to provide continued direction and support to the inquirer.

Curricula should provide time to permit the exploration of related subjects to broaden understanding. You never know what will interest an individual so you cannot decide in advance what they will learn. If anyone should doubt this statement consider how many times you have been faced with the situation that someone did not hear what you said but instead heard only what he/she wanted to hear you say.

Providing a model of what worked in one case is only an example. It is not intended to be copied. It might not work again.

Students need to retain responsibility for their learning, to be diagnosed by teachers, to know the correct answer, to know the answer is correct, to develop self-confidence in order to tackle any problem, to have a positive self-image, to understand what they are doing, to perceive that the teacher is genuinely interested, to connect the subject matter to their own lives, to face challenges, to succeed, opportunities to fail, to relate facts, to receive feed-back, the opportunity to experiment without penalty, to trust the teacher, time to develop at their own rate and the opportunity to demonstrate their accomplishments.

Present Situation

Most current practice, particularly at the secondary level, is not compatible with the above stated philosophy. The usual practice is for teachers to present the material to be assimilated and to do sample questions. Students then practice following these examples. Students receive a test after a specified period of time which is marked by the teacher, returned eventually to the student, the mark is recorded for the student's final grade and the answers may be taken up. The student received the information that he/she has done well, adequately or poorly by the mark on the test or exam. All students take the test at the same time so no allowance is made for students who learn at a slower rate and who are not ready for the test. There is no diagnosis or prescription. Surely the student can notice which questions were marked incorrect but there is little incentive to

determine why his solution was incorrect or what the correct answer is. The test has been marked, the mark has been recorded and this mark is used to determine the final grade and credit. Teachers who argue these tests are diagnostic are being naive. These tests are penalties. Penalties for not learning the subject matter by the predetermined time. Students never have a test for purely diagnostic purposes i.e. with no mark attached.

With the emphasis upon subject matter presentation most of the class time available is occupied with presentation and the doing of sample questions. There is precious little time remaining, or energy for that matter, to deal with the individual student. How can a teacher diagnose the cause for a student's poor performance or lack of understanding if there is no time to do so? It can't be done so it is not done. Hence the burden of determining why the student doesn't understand is left with the student. By assigning questions, taking them up, marking the tests and recording the mark the teacher has assumed all the evaluative processes and since these form the essence of learning, the teacher has assumed the responsibility for the learning or lack thereof. This is exactly the reverse of what ought to be. We see evidence of this transfer of responsibility in the comments

of students such as "The teacher failed me", "The teacher gave me a good mark", and "The teacher gave me a poor mark."

It was for sound pedagogical reasons, then, that the methodology to be described was initiated. To repeat, the initial impetus was to effectively deal with a full spectrum of mathematical abilities in one class but the adoption and continued use was to enhance the learning probability for students. It was a conscious effort to make teaching moral.

We have now come full circle and are advocating the methodology, not only as a more honest and moral teaching approach for almost all classes, but also as a possible way of coping with the individual students in different phases where insufficient numbers due to declining enrollment make different sections impractical.

The Methodology

What follows is a brief description of the methodology alluded to previously. It is not possible to adequately describe the system in writing as there is a component which one can only receive by personal interaction with one who has used it successfully. Further, even a detailed written description is beyond the scope of this monograph.

The methodology has been named Modified Appointment Scheduling. There are many variations, adaptations and modifications possible.

The basic plan will be given. The approach is to essentially make the time period designated a learning-learner centred activity. Succinctly stated the methodology is a combination of a minimal amount of Socratic teaching and a generous amount of group activity providing for a considerable amount of individual interaction between teacher and student as well as between students.

One begins by gaining the confidence of the students and establishing the philosophy and resulting ground rules. The first occasion on which this methodology was used the students involved actually developed the ground rules. These have been handed down to successive classes.

Students are then given an outline of the course both in writing and through an interractive Socratic lesson. The outline indicates the appropriate sections of the test as well. It is hoped that in this manner the students will realize that there is a totality before them to be assimilated and not simply a collection of isolated skills. Self assessment is emphasized together with individual exploration. Diagnostic testing is available at the student's request.

Let us continue sequentially. After the initial terms of reference have been established the course content is begun. Typically an initial-three-day cycle is employed. On day one the new section is presented in all its finery, both intuitively

and formally. Students are led through the content in as meaningful a manner as possible. On day two much of the history and "regality" is removed, the content is "retaught" and several applications explored. The third day sees a synopsis and many applications discussed. Students are advised as to when the next section will begin and are then free to "learn" the current section.

The teacher, in turn, is free to meet with individuals or with the established groups of four to six students by appointment. An appointment can be made for five or ten minutes only. Until students become accustomed to this procedure the teacher phases it in by skillfully determining what is taking place and manoeuvering the students toward the desired behavour. Each group is required to meet with the teacher for ten minutes every week to report on its activities individually and as a group. In addition mini lessons are given when the teacher or the students determine the need for them. Since they occur at the "teachable moment" these mini lessons have a high success rate.

Each student is required to keep a time card on which the student lists the activities he/she was engaged in every day both in class and out of class (here only math related activities are requested.) Students are free to use their time as they will, provided they truly record their activities. These cards are <u>not marked</u>. They <u>are</u> checked and discussed each week. They are intended primarily to reinforce good study habits or point out poor ones.

Group skills are encouraged and indications are given when a group is not working efficiently or is in need of improvement.

When a student feels he/she is ready the individual requests a diagnostic test from the teacher. If a student successfully completes the test he/she is free to continue on. If not, the student continues with the section learning those items which were not known and polishing existing skills. There is no theoretical limit to the number of retests. The number of various forms of the test depend upon the section in question. In some cases there is only one test which leads to the development of a further expectation as well. Successful completion of a test occurs when a test has 80% of the questions correctly done. A typical test has five questions and so a student must answer four out of five questions completely correctly. There is no mark assigned to this test, ever. It is never counted unless the student requests consideration to be given to it. The tests are kept in a file, one for each student, to which both teacher and student has access. Cheating also is minimized through this system since there is no advantage to be gained. A student only loses if he/she cheats. The test is checked immediately. Errors are indicated and students are expected to determine the reason for the error and correct their procedure. There is great motivation to correct their thinking as there is an opportunity to be successful as soon as they are able to remedy the problem.

If the student has been successful the letters O.K. are placed on the test, otherwise, "No" appears. In all cases a

diagnosis of the type of errors present are listed at the top of the answer sheet. Students are free to take as much or as little time as they wish to complete each section. The only constraints are that the next section will begin on the announced date and at mid-term and at the end of the term an examination with set content will be written.

This diagnostic testing provides an opportunity for the student to determine in a test setting his/her deficiencies without penalty. When the section is complete the student can move ahead with confidence since he/she has answered eighty percent of the questions completely correctly.

This procedure is repeated for each section. Students must successfully complete each section before credit will be granted. There is a generous review time allowed prior to the end of the course.

The mid-term examination is marked, returned and students must then determine, correct and explain each error made. To encourage this self-analysis a negotiation procedure is initiated where one succeeds precisely by an accurate determination of one's short-comnings and indicating corrective measures initiated. The mid-term mark is used for the mid-term report only. A minimum of two final exams are written. Satisfactory and consistent marks are expected. In those cases where this has not occurred further exams are taken at specified times. Those who have been successful continue with other assignments.

Each student is expected to successfully complete a project which is of personal interest but related to the course. It is an individual project of any format. The determining criteria are that the project should demonstrate the student's ability to assess his/her own personal situation, select a problem of appropriate difficulty and then learn the matter or solve the problem.

The final mark is determined by the final exams, the project and an evaluation of the final section of the course. There is a possibility of minor adjustments due to "class work".

Advantages

1. Time is available for individualization.
2. The student is responsible for the learning while the teacher bears the burden of diagnosis.
3. Students receive an opportunity for assessment without penalty.
4. The methodology is a moral one. There is complete honesty. The methodology is consistant with expressed goals. There are no conflicts for students between what is stated and what occurs.
5. Group skills are developed.
6. Individual work habits are developed.
7. A holistic approach is possible.
8. Different levels of achievement can be more easily accommodated in one class.
9. Offers a solution in situations resulting from declining enrollment.
10. Develops personal skills as well as mathematical ones.
11. It is learning-learner centred.
12. Gives student the opportunity to be responsible for his/her own learning.
13. Gives student the opportunity to achieve a genuine sense of success.
14. Develops problem solving skills - personal and mathematical.
15. Provides opportunity for programmed challenges both by students and by the teacher.
16. Students are not penalized for being slow starters or rewarded by being able to do small amounts without understanding the whole.

17. Opportunities to develop many of the personal traits necessary in and for society.

18. Allows for different learning styles.

19. Permits varying approaches to the subject matter.

20. Allows one to capitalize on the "teachable moment."

21. Core items are identified.

22. Overlearning of essential points is achieved.

23. Confidence is developed.

24. Definite standards are set.

25. Is ideally suited to develop the logic of the content, to develop applications of the content and make the content of interest to the students.

26. Provides for the opportunity to change phase during the year.

27. Provides the opportunity to challenge the brighter student.

28. Provides the opportunity for students who have had difficulties in mathematics to teach the brighter student. (This happens several times each term and is most gratifying.)

Cautions

1. This methodology works best when there is some unity to the course content. One theme is best but two or three are possible. If there are more than three themes then the methodology becomes artificial.

2. The support of one's colleagues is desirable. At the very least there should be no negative statements made by any fellow teacher. The principal must be willing and c c completely support the methodology. Without this commitment, the methodology, the teacher and the principal suffer.

3. The methodology requires competent teachers - competent both academically and professionally. In only rare cases can this methodology be used by first year teachers and continued direction from an expert is necessary. (There are instances of this occurring.) Professional development of teachers is therefore most necessary. They must not only achieve the technique but also the philosophy.

4. The later in a child's schooling this is begun the more difficult it becomes. Personal attack skills will have become set and the content becomes too rich. Some extra time is required to introduce this approach to the students. The subsequent gain both in content and rate of learning more than compensates for this.

5. If one does not have the complete support of the educational community, if it is introduced quite late in the student's schooling, and if it is used only in an isolated case, frustration can result for the student and the teacher. Perseverance can be severely tested.

Conclusion

The preceding illustrates a methodology which is pedagogically sound, usuable in almost any class, permits the combining of different levels of students in one class and thereby offers a solution where required as a result of declining enrollment.

The reader is cautioned again that it is virtually impossible for someone to successfully initiate this methodology after only having read this monograph. One must be involved at least in a five or six hour reactive session with someone who is well versed in this methodology before trying it with students. It is impossible even to describe and explain all that is involved within the time limits set for this report.

This approach brings significant gain to the students at no additional cost except for the professional development of the teacher. Since this author believes that professional development of teachers is essential (see Professional Development and Declining Enrollment in Ontario) there is no cost at all associated with it. There is a saving in cost if one combines several impractical sections into one. There is a saving of students if one provides for individual differences even though it is not feasible to provide separate sections. For a competent teacher it is no more demanding than the usual approach and far more rewarding.

As a final note, there was an oft repeated comment occurring during the consultations held. It has not been elaborated upon lest the author's favourable bias give disproportionate emphasis to it. The importance of attitude, maturity, and an appropriate set of values continued to be stressed. This moral or value education does not appear in mathematic course outlines. It is this author's belief that moral or value education is not a course unto itself but is a result of discussion and example throughout

the program. Students use the home, the teacher, the other students, the principal, the institution as a model for behaviour. If actions are consistent with the spoken word then the students are apt to modify their behaviour accordingly. If the school is not viewed as being consistent then credibility is lost. "We are going to have a test just to see how you are doing " followed by a recorded graded test is inconsistent. There are many examples of subtle corruption of educator's own words by their own actions. Mathematics is a perfect subject to develop values education and the methodology suggested is more apt to develop positive values than most of those currently being employed in the classroom. Teachers need to remember that they are foremost not teaching subjects but people. The proper maintenance of society is dependent upon this concept.

Recommendations

1. That a task force be established to design an appropriate institutional model for education in view of the projected circumstances, especially that of declining enrollment.

2. That this report be referred to those involved in mathematics curriculum development especially those involved in the proposed new intermediate mathematics guideline.

3. That consideration be given to establishing two major credit levels of mathematics study based upon one level for those who will be pursuing mathematics related fields and another level for those who will not.

4. That steps be taken to ensure that each student and each parent are aware of the intent of the mathematics levels as well as the implications of choice decisions.

5. That the guidelines stress the development of the child as well as course content. This should be done by indicating examples as well as providing descriptive statements.

6. That the Ministry of Education contact the last president of the Ontario Mathematics Commission with a view to resurrecting the organization on the basis of Ministry funding. The Commission is to provide on-going counsel to the Minister with regard to the mathematics curriculum.

7. That the proposed new guidelines for intermediate mathematics be re-examined carefully prior to initiation.

8. That the needs of the individual student continue to be met despite declining enrollment.

9. That provisions continue to be available to students to change phase, preferably even during each term.

10. That mathematic guidelines ensure that a well-balanced program will be offered to students (a balance of logical, sociological and psychological meaningfulness.)

11. That mathematics guidelines be developed which suggest possible adaptations for different learning styles.

12. That guidelines in other disciplines which offer practical uses of mathematical principles point out these applications clearly.

13. That values education be included in all courses and teachers be encouraged to recognize their responsibility to develop values in the course of all subject disciplines.

14. That teachers and administrators ensure that their procedures are consistent with the values they wish the students to adopt.

15. That the Modified Appointment Scheduling methodology be brought to the attention of all teachers and administrators both as a method for coping with declining enrollment and as a practical methodology for most situations.

16. That seminars describing the Modified Appointment Scheduling methodology be provided to those interested.

17. That teachers be encouraged to permit the responsibility for learning to be retained by the student while they, the teachers, assume the burden of diagnosing problems.

18. That opportunities for professional development of teachers be expanded.

19. That a co-ordinated plan for professional development be initiated.

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